TABLE 4 SWELL OF SR COMPOUNDS IN OIL

Time, hr	Volume increase at 70 C, per cent ASTM No. 1	ASTM No. 2	ASTM No. 3
	Cpd. 1 (NR tuads cure)		
24	41	63	123
48	56	85	137
168	73	114	141
336	77	121	149
720	81	129	161
1440	92	139	181
	Cpd. 2 (GR-S)		
24	19	35	93
48	23	50	113
168	35	81	121
336	37	98	121
720	39	91	125
1440	38	105	133
	Cpd. 3 (Neoprene)		
24	4	12	35
48	5	17	49
168	9	31	70
336	10	39	75
720	31	45	81
1440	11	49	85
	Cpd. 4 (Hycar CR-15)		
24	1.4	2	5
48	4.0	3	6
168	0.7	3	6
336	−7.0	7	7
720	0.9	2	7
1440	−2.0	7	6

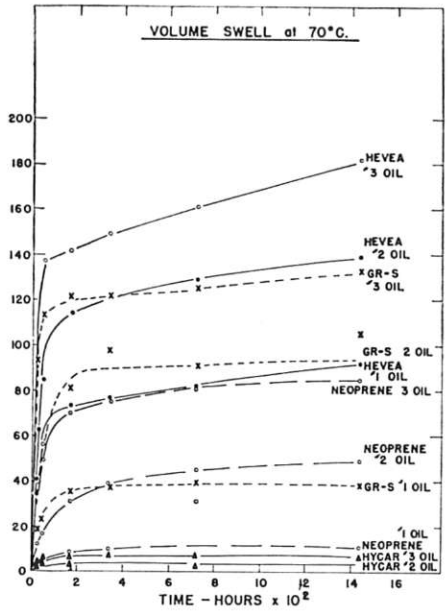

FIG. 13 VOLUME SWELL AT 70 C

Correlation of Volume Swell and Stress Relaxation. Neither volume swell nor increase in stress of the stress-relaxation tests has reached equilibrium at 1440 hr but the volume-swell curves appear to have reached a somewhat constant slope so it was assumed that a pseudo equilibrium had been attained in that the rates were probably of the same order of magnitude at this time. The significance of this correlation of stress increase and volume swell (shown in Fig. 14) is that the former may be predicted from the data of the latter, more easily performed, test.

The practical implications of this study are that rubber compounds which swell in the presence of oil have a property which may be utilized in some applications where it may serve a useful purpose. Examples are O-ring seals, and other types of gaskets where the rubber is used in compression. In these cases the

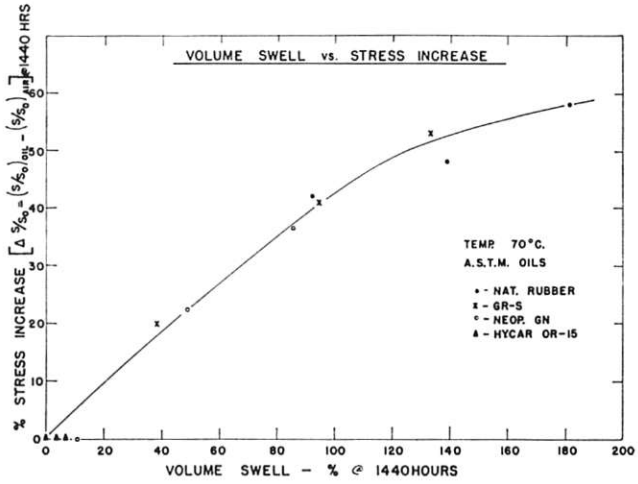

FIG. 14 VOLUME SWELL VERSUS STRESS INCREASE

stress decays more slowly with time and in some cases the force would increase and the tendency to leakage would be minimized. In these experiments the sample was relatively unconfined except for the direction of loading with only low frictional forces which tended to prevent increase in volume. It was noted that with natural rubber and GR-S at 70 C the stress reached a maximum between 1000 and 10,000 hr which is a result of the sample reaching equilibrium with respect to swelling by the oil and the stress then decreases depending on the oxidative scission of bonds in the same manner as found for tests conducted in air. However, according to Scott (2) the attack of swelling agents accelerates oxidation so it is possible that this oxidative scission might be in addition to that normally measured in air (3).

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Discussion

F. C. THORN.[3] The paper describes the effect of oil absorption in counteracting relaxation. Are data also available as to the effect of confinement in counteracting oil absorption? In other words, are there figures for the weight or volume increase in the

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samples at the conclusion of the test, as compared to similar figures for unconfined samples?

Authors' Closure

Qualitative data indicated essentially no volume increase of the samples under compression until the stress began to decay rapidly between 5,000 and 10,000 hours for natural rubber and GR-S at 70 C. A volume increase, i.e., a diameter increase was noted at this interval. This may be compared with Fig. 13 which shows the volume change of unconfined rubber specimens.